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# 7 Pavement Joints

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## Types of Joints

*D-1 Contraction Joints*

*Longitudinal Joints*

*Transverse Construction Joints*

*Terminal Joints*

*Expansion Joints*

*Retro-fitted Tie Bars*

## Sealing Joints

# ***CHAPTER SEVEN:***

## ***PAVEMENT JOINTS***

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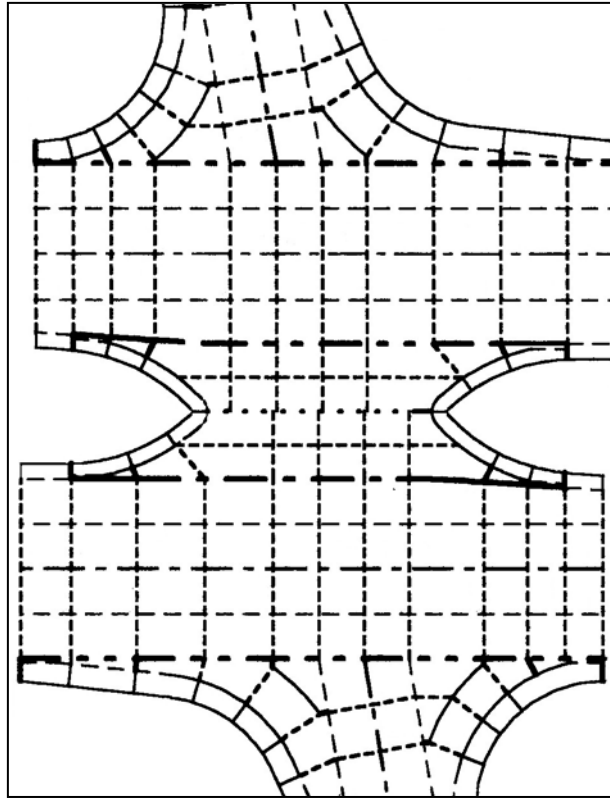
Pavement joints are vital to control pavement cracking and pavement movement. Without joints, most concrete pavements would be riddled with cracks within one or two years after placement. Water, ice, salt and loads would eventually cause differential settlement and premature pavement failures. These same effects may be caused by incorrectly placed, or poorly designed pavement joints. The technician is responsible for inspecting all joints to avoid any of the problems associated with joint failure.

Forethought should be given to the design and placement of the pavement joints so that the end result is a properly functioning pavement system. Special care should be given at intersecting approaches, turn lanes and crossovers so that the joints required at these locations will complement the joints placed in the mainline pavement. Since the mainline pavement is typically placed prior to any auxiliary pavement, the location of all joints should be known in advance of the initial pours. If the initial joint placement is correct, the extension of the same joint lines throughout any adjacent pavements is done. "Dead ending" of joints in the middle of adjacent slabs should be avoided whenever possible to avoid the risk of reflective cracking.

An example of a well planned joint design is shown in Figure 7-1. The joints in this diagram are continuous from edge of pavement to edge of pavement. Also, the joints in the mainline pavement are aligned to serve the joints in the adjoining pavements.

The following concrete pavement joints and related materials will be discussed:

- 1) D-1 contraction joints
- 2) Longitudinal joints
- 3) Transverse construction joints
- 4) Terminal joints
- 5) Expansion joints
- 6) Retrofitted tie bars



**Figure 7-1. Pavement Joint Design**

## **TYPES OF JOINTS**

There are many types of joints used in the construction of concrete pavement but they all serve the same basic purpose; to control the movement of the pavement and the associated cracking and/or differential settlement.

Unless otherwise indicated, all joints are placed perpendicular to the grade. Longitudinal joints are placed parallel to the center line, and transverse joints are placed at right angles to the center line for the full width of the pavement. Understanding the use and function of the different types of joints is required in determining their placement.

### ***D-1 CONTRACTION JOINTS***

Typically, a contraction joint is a sawed transverse joint normally placed every 18 feet to control cracking due to pavement contraction caused by shrinkage and temperature fluctuations. The plans for the particular contract should be checked to verify the proper joint placement. The minimum/maximum joint spacing should be reviewed with the Area Engineer or District Construction Engineer so that joints may be established in the initial pours that will complement adjacent pavements.

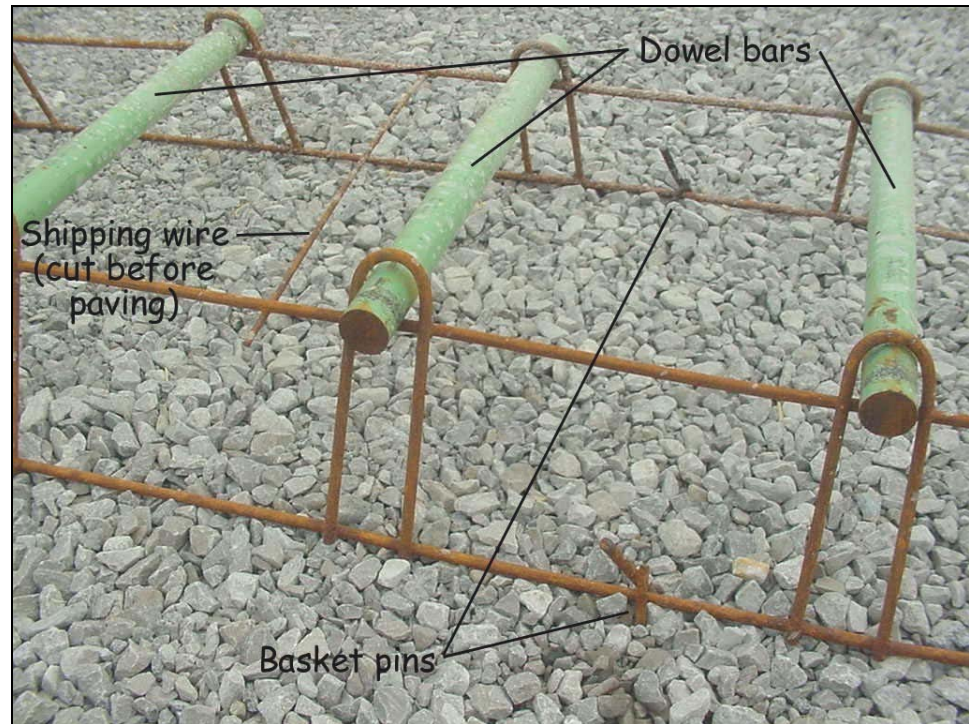
A dowel bar assembly (Figure 7-2), commonly called a "basket", is placed on the subgrade before paving at the location of the contraction joint. The steel bars of this assembly are large and, once incorporated into the concrete pavement, transfer the vehicular load from one slab to another, eliminating differential settlement at the joint.



**Figure 7-2. Dowel Bar Baskets**

The location of the center of the dowel bar assembly is marked outside of the form/slab line so that the dowel bar assembly may be established once the pavement is in place. These locations are maintained during the pouring operations because the markings may easily become disturbed during construction. The dowel bar assemblies are to be securely fixed to the subgrade by using metal pins to eliminate displacement by the plastic concrete (Figure 7-3). The Specifications should be checked to determine the number of pins required for the different length assemblies.





**Figure 7-3. Dowel Bar Basket Detail**

The technician is required to monitor the locations of the reinforcing steel, placed as tie bars in the edges and at the center line of the pavement, to insure that the tie bars do not interfere with the operation of the D-1 joint. Tie bars placed over a basket assembly should be adjusted longitudinally so that they do not hamper the movement designed into the joint. The longitudinal adjustment required should seldom be more than 1 foot (Figure 7-4).



**Figure 7-4. Basket Adjustment**

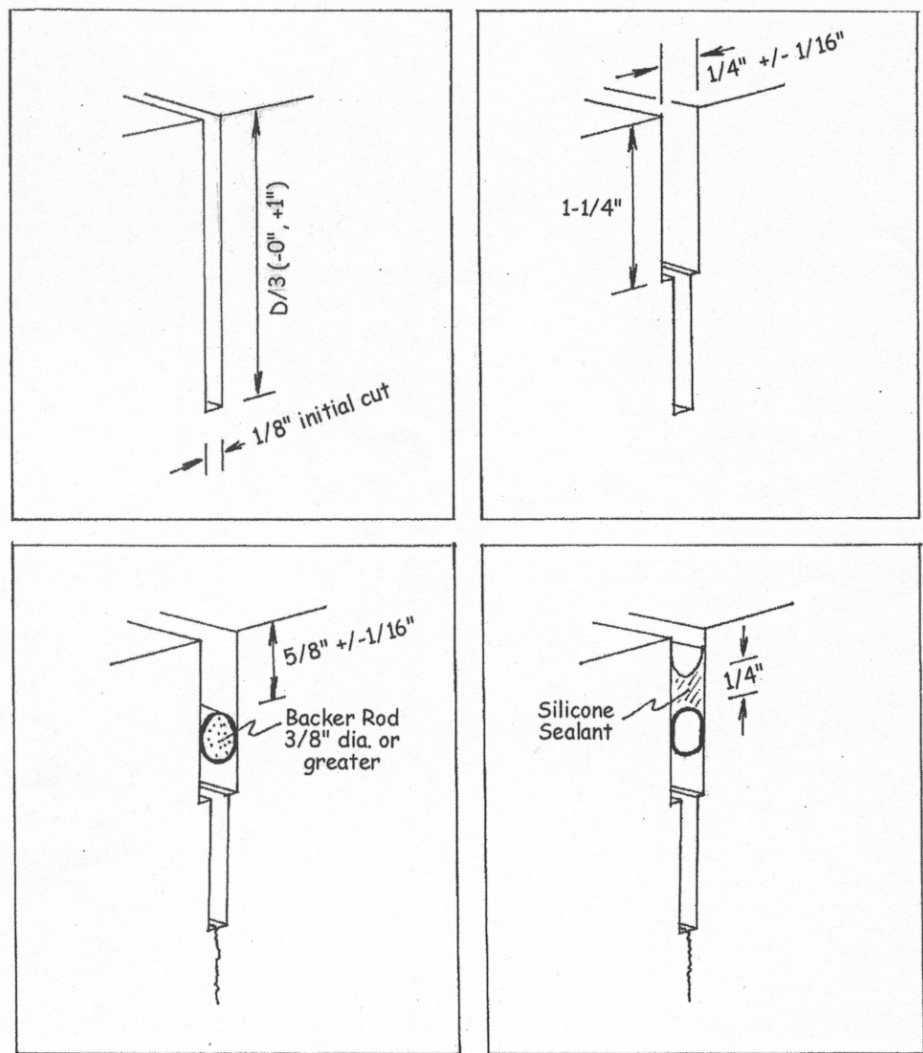
After paving, the locations of the dowel bar assemblies are marked on the pavement and the initial saw cut is made for the joint. Timing is critical when making this saw cut on contraction joints. If sawed too soon, the joint will spall and ravel. If sawed too late, the pavement will already have cracked randomly. For this reason, the sawing of joints often starts within 2 to 12 hours of the time of placement, depending upon the ambient/material temperature, humidity, and wind conditions. The initial sawing of a pavement will continue, night and day, regardless of weather conditions until complete. If random cracking is observed ahead of current sawing operations, the sawing operations should be advanced until the random cracking is controlled. The joint is required to be sawed straight for the full depth, width, and length of the joint. The technician is responsible for checking these requirements.

If a slurry is created by the sawing operation, this material is required to be flushed with high pressure water to remove the slurry to the entire depth of the joint. Care should be taken not to damage the pavement while flushing because the concrete is still "green" and vulnerable to damage from excessive force. If the slurry is not removed from the joint, this material hardens and the joint is required to be re-sawed.

Just prior to sealing, the joint is blown with a jet of compressed air, or otherwise cleaned, to remove all foreign material and prepare the joint faces for the sealer. After cleaning, a backer rod is installed and the joint sealer is applied. The depth of the backer rod and thickness of joint sealer is critical for a properly functioning joint. The depth at which the backer rod is set establishes the bottom of the joint sealer. The depth, and thickness at which the sealer is installed is required to be monitored by the technician. The surface of the sealer is required to be below the surface of the pavement so that traffic does not damage the sealer. Also, the thickness is critical so that the elasticity of the sealer is maintained. This is an instance where more is not better. Specifications and/or Standards should be consulted to determine the proper placement.

All joints are required to be sealed prior to opening a section of pavement to any traffic, other than construction traffic, or before the end of the current construction season. The steps in constructing a D-1 contraction joint (Figure 7-5) include the following:

- 1) A 1/8 inch cut is made in the pavement for the full width and proper depth of the joint.
- 2) The final cut is made to prepare the joint for the backer rod and sealant.
- 3) The joint is thoroughly cleaned and a backer rod is installed at the proper depth.
- 4) The sealant is installed to the proper depth and thickness.



**Figure 7-5. D-1 Contraction Joint**



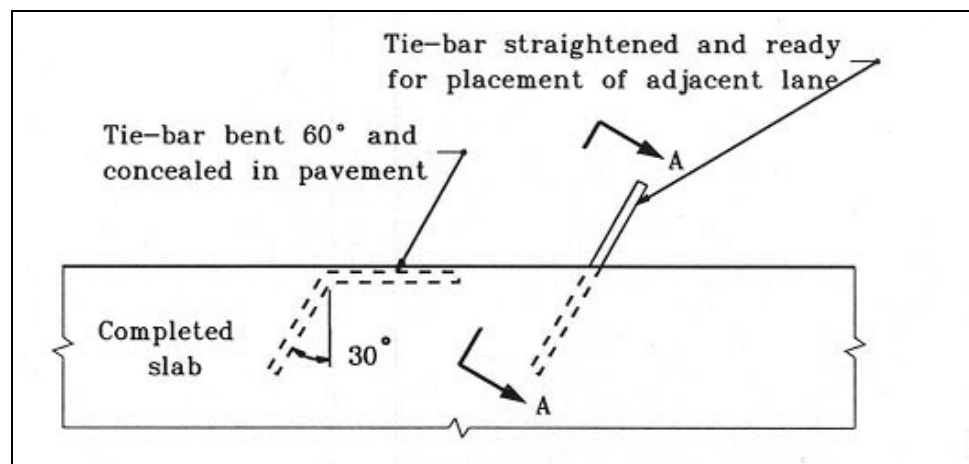
## **LONGITUDINAL JOINTS**

A longitudinal joint (Figure 7-6) is required in all pavements wider than 16 feet. If two adjacent lanes are poured at the same time, a longitudinal joint is sawed.



**Figure 7-6. Longitudinal Joint**

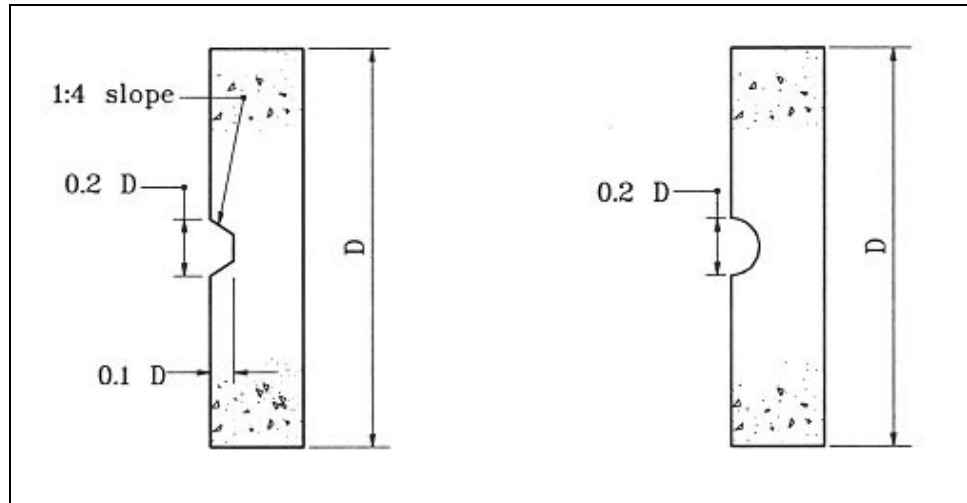
Tie bars, when required, are placed perpendicular to the longitudinal joint and parallel to the grade. Tie bars may be machine placed during paving or secured with chairs prior to paving. When tie bars are required along the form line or the edge of a slip-formed lane, bent bars are used. Bent bars are tie bars bent at a 60° angle. These bars are straightened after the concrete sets so that they will extend into an adjacent lane. Special care is required to be taken when the tie bars are inserted in the side of a slip-formed pavement to assure no detrimental edge slump is caused by this operation.



**Figure 7-7. Tie-Bar for Longitudinal Joint**



Some longitudinal joints require the use of a keyway with no tie bars. Keyways (Figure 7-8) may be trapezoidal or semi-circular in shape. They are used when an adjacent pavement is expected to move independently and the two pavements cannot be tied together. The keyway, prevents any differential settlement of either pavement.



**Figure 7-8. Keyway Joints**

Longitudinal sawed joints are cut with a power concrete saw concurrently with the contraction joints. The plans and/or Standards Drawings should be checked for the proper depth, width, line, and type of seal required.

#### ***TRANSVERSE CONSTRUCTION JOINTS***

A transverse construction joint is used when the paving operation is interrupted for longer than 30 minutes. These joints are commonly used at the end of the paving operation each day and may be retro-fitted to tie an existing slab into a new pavement. Transverse construction joints are required to be located at least 6 feet from an adjacent D-1 contraction joint.

Spacing of the tie bars in the construction joint is required to be 6 inches from any longitudinal joint and 1 foot, center to center, thereafter. The tie bars are required to be epoxy coated and inserted through a header board set to the proper line and grade. Care should be taken to assure that the bars are placed parallel to the grade and the centerline.



### ***EXPANSION JOINTS***

Expansion joints consist of a preformed joint filler, generally 1 inch thick, that compresses and allows the pavement to expand. The joints are placed at the locations noted on the plans. The joint filler is required to be shaped to the subgrade, parallel to the surface, and the full width of the pavement. The edges of the expansion joint are to be finished.

### ***RETRO-FITTED TIE BARS***

When new pavement is to be tied to an existing pavement, tie bars are used to tie the pavements together. Holes are drilled into the existing pavement for the epoxy coated tie bars. An approved chemical anchoring system, generally epoxy, is used to secure the tie bar in the hole. The size of the drilled hole is required to be in accordance with the recommendations of the anchoring system manufacturer for the size bar being inserted. Once the adjacent pavement has been poured, the joint is sawed and sealed the same procedure as required for a construction joint.

### **SEALING JOINTS**

Before sealing, the joint is required to be clean of all foreign materials. This is accomplished by water blasting, sand blasting, mechanical wire brushing, or a combination thereof. Care should be taken not to damage the joint when cleaning. All residue of the sawing operation is required to be removed from the joint face for proper sealant adhesion. A quick test for cleanliness may be made by inserting a small clean object into the joint. If residue or dust is retained on the object, additional cleaning is required. Once the joint has been thoroughly cleaned, the backer rod may be installed, if required, and the sealer may be placed.

All joints are to be sealed prior to discontinuing work for the construction season or before opening the pavement to public traffic. Construction traffic may be allowed upon the pavement prior to this sealing process. (Standard Drawings **E503-CCPJ-01, E503-CCPJ-02, E503-CCPJ-03, E503-CCPJ-04, E503-CCPJ-05, E503-CCPJ-06, E503-CCPJ-07 and E503-CCPJ-08**)